

Topic 2: Organization of the Organism

2.1 Cell Structure

Animal and Plant Cells

Feature	Animal Cell	Plant Cell
Cell Wall	Absent	Present (made of cellulose)
Chloroplasts	Absent	Present (for photosynthesis)
Shape	Irregular/Round	Fixed/Regular (due to cell wall)
Storage	Glycogen	Starch or Sucrose
Vacuole	Small, temporary, or absent	Large, permanent central vacuole

Common Cell Structures and Functions

Structure	Location	Function
Nucleus	Present in both	Contains genetic material (DNA) and controls cell activities.
Cytoplasm	Present in both	Jelly-like substance where chemical reactions take place.
Cell Membrane	Present in both	Partially permeable barrier that controls which substances enter and leave the cell.
Mitochondria	Present in both	Site of aerobic respiration ; releases energy (ATP) .
Ribosomes	Present in both	Site of protein synthesis .
Cell Wall	Plant cells only	Provides support and a fixed shape to the cell.
Chloroplasts	Plant cells only	Site of photosynthesis ; contains the pigment chlorophyll .
Vacuole	Plant cells only	Stores cell sap (water, sugars, salts); maintains turgor pressure .

Specialized Cells

- **Ciliated Cells:** Found in the trachea and bronchi. They have **cilia** (tiny hairs) that sweep mucus and trapped particles out of the lungs.
 - **Root Hair Cells:** Found in plant roots. They have a **large surface area** to absorb water and mineral ions from the soil.
 - **Xylem Vessels:** Transport **water and mineral ions** from the roots to the leaves. They are dead, hollow tubes with thickened, lignified walls for support.
 - **Phloem Vessels:** Transport **sucrose and amino acids** (products of photosynthesis) from the leaves to other parts of the plant.
 - **Red Blood Cells:** Transport **oxygen**. They have **no nucleus** to maximize space for haemoglobin and a **biconcave shape** to increase surface area.
 - **Sperm and Egg Cells:** **Gametes** for sexual reproduction. Sperm are small and motile; egg cells are large and contain food reserves.
- (Each of these is covered in more details in further chapters)

Levels of Organization

Living organisms are organized into a hierarchy of structures:

- 1 **Cell:** The basic structural and functional unit of all living organisms (e.g., muscle cell, root hair cell).
- 2 **Tissue:** A group of **similar cells** working together to perform a specific function (e.g., muscle tissue, xylem tissue).
- 3 **Organ:** A structure made up of **different tissues** working together to perform a specific function (e.g., heart, leaf).
- 4 **Organ System:** A group of **different organs** working together to perform a specific function (e.g., circulatory system, digestive system).
- 5 **Organism:** A complete living thing.

2.2 Size of Specimens and Microscopy

Calculating Magnification

The relationship between image size, actual size, and magnification is given by the formula:

$$\text{Magnification} = \frac{\text{Image size}}{\text{Actual size}}$$

- **Image Size** and **Actual Size** must be in the **same units** (e.g., both in **µm** or both in **mm**).

Converting Units

It is essential to be able to convert between units of length:

Unit	Equivalent in Meters	Conversion
Meter (m)	1	Base unit
Millimeter (mm)	10 ⁻³	1m = 1000 mm
Micrometer (µm)	10 ⁻⁶	1µm = 1000 mm
Nanometer (nm)	10 ⁻⁹	1nm = 1000 µm